

Appl. No. 10/798,614
Amdt. Dated January 12, 2009
Reply to O.A. of December 10, 2008

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Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (withdrawn) A system for determining a position and a change in the position of an anatomical structure, comprising:

a surgical navigation system;

a substrate including means for removably attaching the substrate to an outer surface of a body, wherein the body includes an anatomical structure;

a sensor attached to the substrate that can be tracked by the surgical navigation system;

an ultrasonic imaging device attached to the substrate;

a passive point source adapted to be disposed adjacent the anatomical structure, wherein the ultrasonic imaging device and the passive point source are utilized to determine a position of the anatomical structure;

a first circuit for calculating a global position of the anatomical structure by correlating a position of the sensor and the position of the anatomical structure; and

a second circuit for displaying the global position of the anatomical structure on a display unit.

2. (withdrawn) The system of claim 1, wherein the sensor is an optical tracking device.

3. (withdrawn) The system of claim 2, wherein the optical tracking device includes three LED's.

4. (withdrawn) The system of claim 1, wherein the anatomical structure is a bony structure.

5. (withdrawn) The system of claim 1, wherein multiple ultrasonic imaging devices simultaneously track the position of the anatomical structure.

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6-7. (canceled)

8. (withdrawn) The system of claim 1, wherein the ultrasonic imaging device comprises three ultrasound transducers.

9. (withdrawn) The system of claim 8, wherein the passive point source comprises three sonic reflective balls disposed adjacent the anatomical structure.

10. (withdrawn) The system of claim 9, wherein the sonic reflective balls are substantially composed of air.

11. (withdrawn) The system of claim 9, wherein the sonic reflective balls are composed of a resorbable material.

12. (withdrawn) The system of claim 9, wherein at least one of the three ultrasound transducers emits an ultrasonic beam, and wherein the ultrasonic beam is reflected by a first sonic reflective ball to the ultrasound transducers.

13-14. (canceled)

15. (withdrawn) The system of claim 1, wherein the first circuit determines the global position of the anatomical structure without the use of an image of the anatomical structure.

16-19. (canceled)

20. (withdrawn) The system of claim 47, wherein the fiber optic device is connected to a retrieval device.

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21-23. (canceled)

24. (withdrawn) A system for determining a position and a change in the position of an anatomical structure, comprising:

a surgical navigation system;

a substrate including means for removably attaching the substrate to an outer surface of a body, wherein the body includes an anatomical structure;

a sensor attached to the substrate that can be tracked by the surgical navigation system;

an ultrasonic imaging device attached to the substrate;

an active point source adapted to be disposed adjacent the anatomical structure, wherein the ultrasonic imaging device and the active point source are utilized to determine a position of the anatomical structure;

a first circuit for calculating a global position of the anatomical structure by correlating a position of the sensor and the position of the anatomical structure, wherein the first circuit determines the global position without the use of an image of the anatomical structure; and

a second circuit for displaying the global position of the anatomical structure.

25. (withdrawn) The system of claim 24, wherein the substrate is adapted to be fixedly mounted to the outer surface of the body using an ultrasonic coupling adhesive.

26. (withdrawn) The system of claim 24, wherein the substrate is approximately 5cm in width and approximately 5cm in length.

27. (withdrawn) The system of claim 24, wherein the sensor is an optical tracking device.

28. (withdrawn) The system of claim 27, wherein the optical tracking device includes three LED's.

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29. (withdrawn) The system of claim 24, wherein the anatomical structure is a bony structure.

30. (canceled)

31. (withdrawn) The system of claim 24, wherein multiple ultrasonic imaging devices simultaneously track the position of the anatomical structure.

32. (withdrawn) The system of claim 24, wherein the ultrasonic imaging device comprises a plurality of receivers.

33-36. (canceled)

37. (withdrawn) The system of claim 32, wherein the active point source comprises three source transducers disposed adjacent the anatomical structure.

38. (withdrawn) The system of claim 37, wherein at least one of the three source transducers emits an ultrasonic beam, and wherein the ultrasonic beam is received by the receivers.

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39. (previously presented) A device for determining a position and a change in the position of an anatomical structure for use with a surgical navigation system, comprising:

a substrate including means for removably attaching the substrate to an outer surface of a body, wherein the body includes an anatomical structure;

a sensor attached to the substrate that can be tracked by the surgical navigation system;

a magnetic transmitter attached to the substrate;

a magnetic sensor comprising means for attachment to the anatomical structure,

wherein the magnetic transmitter and the magnetic sensor are utilized to determine a position of the anatomical structure;

a first circuit for calculating a global position of the anatomical structure by correlating a position of the sensor and the position of the anatomical structure; and

a second circuit for displaying the global position of the anatomical structure on a display unit.

40. (original) The device of claim 39, wherein the sensor is an optical tracking device.

41. (original) The device of claim 40, wherein the optical tracking device includes three LED's.

42. (original) The device of claim 39, wherein the anatomical structure is a bony structure.

43-44. (canceled)

45. (previously presented) The device of claim 39, wherein the means for attachment includes an anchor.

46. (previously presented) The device of claim 39, wherein the magnetic sensor is connected to a retrieval device.

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47. (withdrawn) A system for determining a position and a change in the position of an anatomical structure, comprising:

a surgical navigation system;

a substrate including means for removably attaching the substrate to an outer surface of a body, wherein the body includes an anatomical structure;

a sensor attached to the substrate that can be tracked by the surgical navigation system;

a fiber optic device attached to the substrate that determines a position of the anatomical structure relative to the sensor;

a first circuit for calculating a global position of the anatomical structure by correlating a position of the sensor and the relative position of the anatomical structure; and

a second circuit for displaying the global position of the anatomical structure.

48. (withdrawn) The system of claim 47, wherein the sensor is an optical tracking device.

49. (withdrawn) The system of claim 48, wherein the optical tracking device includes three LED's.

50. (withdrawn) The system of claim 47, wherein the anatomical structure is a bony structure.

51. (withdrawn) The system of claim 47, wherein multiple fiber optic devices simultaneously track the position of the anatomical structure.

52. (withdrawn) The system of claim 47, wherein the fiber optic device comprises a fiber and an anchor.

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53. (withdrawn) The system of claim 52, wherein the fiber includes a serrated portion for the emission of light along a length of the fiber.

54. (withdrawn) The system of claim 53, wherein the serrated portion is covered by a light absorbent material.

55. (withdrawn) The system of claim 52, wherein the anchor comprises a pin that is adapted to be removably attached to the anatomical structure, and wherein the fiber is attached to the pin.

56. (currently amended) A method for determining a position and a change in the position of an anatomical structure using a surgical navigation system, the method comprising the steps of:
attaching a substrate in a removable manner to an outer surface of a body, the substrate having an associated sensor and having a positional device ~~on the substrate~~ for determining a position of the anatomical structure relative to the sensor, wherein the positional device includes a magnetic transmitter attached to the substrate and a magnetic sensor comprising means for attachment to the anatomical structure, and wherein the body includes an anatomical structure spaced interiorly from the outer surface, the magnetic transmitter and the magnetic sensor are utilized to determine a position of the anatomical structure, and the sensor is tracked by the surgical navigation system;

determining the position of the anatomical structure by correlating a position of the sensor and the position of the anatomical structure; [[and]]

tracking the position of the anatomical structure with the surgical navigation system; and displaying the position of the anatomical structure on a display unit.

57. (original) The method of claim 56, wherein the sensor is an optical tracking device.

58. (original) The method of claim 57, wherein the optical tracking device includes three LED's.

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59. (original) The method of claim 56, wherein the anatomical structure is a bony structure.

60. (original) The method of claim 56, wherein multiple positional devices simultaneously determine the position of the anatomical structure.

61. (withdrawn) The method of claim 56, wherein the positional device is an ultrasonic imaging device.

62. (withdrawn) The method of claim 61, wherein the ultrasonic imaging device comprises three ultrasound transducers.

63. (currently amended) The method of claim 56, including the step of placing the magnetic sensor ~~a position indicating structure~~ next to the anatomical structure ~~that interacts with the positional device~~.

64. (withdrawn) The method of claim 63, wherein the position indicating structure is a sonic reflective ball and the positional device comprises a plurality of ultrasound transducers.

65. (withdrawn) The method of claim 64, wherein the sonic reflective ball is substantially composed of air.

66. (withdrawn) The method of claim 64, wherein the sonic reflective ball is composed of a resorbable material.

67. (withdrawn) The method of claim 64, wherein the position indicating structure comprises three sonic reflective balls.

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68. (withdrawn) The method of claim 63, wherein the position indicating structure comprises three source transducers and the positional device comprises a plurality of receivers.

69. (withdrawn) The method of claim 68, wherein at least one of the three source transducers emits an ultrasonic beam, and wherein the ultrasonic beam is received by the receivers.

70. (withdrawn) The method of claim 61, wherein the position of the anatomical structure is tracked without the use of an image of the anatomical structure.

71. (withdrawn) The method of claim 63, wherein the position indicating structure comprises one fiber and an anchor.

72. (withdrawn) The method of claim 71, wherein the fiber includes a serrated portion for the emission of light along a length of the fiber.

73. (withdrawn) The method of claim 72, wherein the serrated portion is covered by a light absorbent material.

74. (withdrawn) The method of claim 71, wherein the anchor comprises a pin that is removably attached to the anatomical structure, and wherein the fiber is attached to the pin.

75. (withdrawn) The method of claim 71, wherein the position indicating structure is connected to a retrieval device.

76. (canceled)

77. (currently amended) The method of claim 56 [[76]], wherein the magnetic sensor includes a pin removably attached to the anatomical structure.

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78. (currently amended) The method of claim 56 [[76]], wherein the magnetic sensor is in a connected relation to a retrieval device.

79. (previously presented) The method of claim 56, wherein the step of tracking the position of the anatomical structure is performed without using a reference device invasively affixed to the body.

80. (withdrawn) The method of claim 64, further comprising the step of injecting the sonic reflective ball percutaneously under the positional device.

81. (withdrawn) The method of claim 61, further comprising the step of applying a slight motion to the ultrasonic imaging device to create at least one differential distance map of the anatomical structure.

82. (withdrawn) The method of claim 81, further comprising the step of correlating data from a plurality of differential distance maps to establish an arbitrary initial distance map.

83. (withdrawn) The method of claim 82, further comprising the step of comparing the position of the anatomical structure to the arbitrary initial distance map to determine a change in the position of the anatomical structure.

84. (previously presented) The method of claim 60, further comprising the step of calibrating the multiple positional devices by using a calibration object to determine relative distances between the positional devices.

85. (withdrawn) The method of claim 84, wherein the positional devices comprise ultrasonic imaging devices and the calibration object comprises a needle with an ultrasonic tip.

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86. (withdrawn) The method of claim 68, further comprising the step of determining a position of each source transducer by activating one source transducer at a time to emit an ultrasonic beam and receiving each ultrasonic beam by the receivers.

87. (previously presented) The device of claim 46, wherein the retrieval device comprises a wire.

88. (withdrawn) The system of claim 20, wherein the retrieval device comprises a tubular attachment.

89. (previously presented) The device of claim 39, further comprising a plurality of magnetic sensors, wherein each of the magnetic sensors comprises means for attachment to the anatomical structure, and wherein the magnetic transmitter and the plurality of magnetic sensors are utilized to determine the position of the anatomical structure.

90. (previously presented) The device of claim 46, wherein the retrieval device is attached to the substrate.

91. (currently amended) The method of claim 63, further comprising the step of transcutaneously placing the magnetic sensor ~~position-indicating structure~~ next to the anatomical structure through a sleeve with an impaction device.

92. (currently amended) The method of claim 56 ~~[[76]]~~, further comprising ~~wherein the position-indicating structure comprises~~ a plurality of magnetic sensors that are placed next to the anatomical structure and interact with the magnetic transmitter.

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93. (currently amended) The method of claim 56 [[76]], wherein the magnetic sensor includes an anchor removably attached to the anatomical structure.

94. (previously presented) The method of claim 78, wherein the retrieval device is a wire.

95. (previously presented) The method of claim 94, wherein the wire is attached to the substrate.